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CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)

09/622290

INTERNATIONAL APPLICATION NO.  
PCT/DE99/03143INTERNATIONAL FILING DATE  
(30.09.99)  
30 September 1999PRIORITY DATES CLAIMED  
(14.12.98)  
14 December 1998

## TITLE OF INVENTION

ASSEMBLING DEVICE FOR ASSEMBLING AND DISASSEMBLING A FUEL INJECTOR

## APPLICANT(S) FOR DO/EO/US

HANS, Waldemar; LINSSEN, Mathias; and VOGEL, Christof

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
  2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
  3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) immediately rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
  4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
  5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
    - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
    - b. ☒ has been transmitted by the International Bureau.
    - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
  6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
  7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
    - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
    - b. ☐ have been transmitted by the International Bureau.
    - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
    - d. ☒ have not been made and will not be made.
  8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
  9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). (Unsigned)
  10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).
- Items 11. to 16. below concern other document(s) or information included:**
11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
  12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
  13. ☒ A **FIRST** preliminary amendment.
    - ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
  14. ☐ A substitute specification.
  15. ☐ A change of power of attorney and/or address letter.
  16. ☒ Other items or information: Copies of International Search Report and Form PCT/RO/101.

EXPRESS NO.

EL30270029345

09/622290

17. ☒ The following fees are submitted:**Basic National Fee (37 CFR 1.492(a)(1)-(5)):**

Search Report has been prepared by the EPO or JPO ..... \$840.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) ... \$670.00

No international preliminary examination fee paid to USPTO (37 CFR 1.482) but  
international search fee paid to USPTO (37 CFR 1.445(a)(2)) ..... \$750.00Neither international preliminary examination fee (37 CFR 1.482) nor international  
search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... \$970.00  
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all  
claims satisfied provisions of PCT Article 33(2)-(4) ..... \$30.00

CALCULATIONS | PTO USE ONLY

**ENTER APPROPRIATE BASIC FEE AMOUNT =**

\$840

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months  
from the earliest claimed priority date (37 CFR 1.492(e)).

\$

Claims

Number Filed

Number Extra

Rate

Total Claims

10 - 20 =

0

X \$18.00

\$ 0

Independent Claims

1 - 3 =

0

X \$78.00

\$ 0

Multiple dependent claim(s) (if applicable)

+ \$60.00

\$

**TOTAL OF ABOVE CALCULATIONS =**

\$ 840

Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must  
also be filed. (Note 37 CFR 1.9, 1.27, 1.28).

\$

**SUBTOTAL =**

\$ 840

Processing fee of \$130.00 for furnishing the English translation later than ☐ 20 ☐ 30  
months from the earliest claimed priority date (37 CFR 1.492(f)).

+

\$

**TOTAL NATIONAL FEE =**

\$ 840

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be  
accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property

+

\$

**TOTAL FEES ENCLOSED =**

\$ 840

Amount to be:

refunded

\$

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\$

- a. ☐ A check in the amount of \$\_\_\_\_\_ to cover the above fees is enclosed.
- b. ☒ Please charge my Deposit Account No. 11-0600 in the amount of **\$840.00** to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 11-0600. A duplicate copy of this sheet is enclosed.

**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Kenyon & Kenyon  
One Broadway  
New York, New York 10004

SIGNATURE

Richard L. Mayer, Reg. No. 22,490

NAME

DATE

8/14/00

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Inventor(s) : Waldemar HANS et al.  
Serial No. : To Be Assigned  
Filed : Herewith  
For : ASSEMBLING DEVICE FOR ASSEMBLING AND  
DISASSEMBLING A FUEL INJECTOR  
Examiner : To Be Assigned  
Art Unit : To Be Assigned

Assistant Commissioner for Patents  
Washington, D.C. 20231

**PRELIMINARY AMENDMENT**

SIR:

Kindly amend the above-identified application before  
examination, as set forth below.

**IN THE SPECIFICATION:**

Please amend the specification as follows.

On page 1, delete lines 1-2, and insert:

--FIELD OF THE INVENTION--.

On page 1, line 4, change "in particular" to --for  
example--.

On page 1, delete lines 10-11, and insert:

--BACKGROUND INFORMATION--.

On page 1, line 13, change "already known from" to  
--described in--.

On page 1, line 14, change "197 05 990 A1, a" to  
--No. 197 05 990. A--.

On page 1, line 15, change "being" to --is--.

On page 1, line 16, change "being" to --is--.

EL30270029SUS

On page 1, line 27, change "because" to --of--.

On page 1, line 29, after "be" insert  
--disadvantageously--.

On page 1, line 30, change "tools, which is  
disadvantageous." to --tools.--.

On page 1, line 31, change "known" to  
--conventional--.

On page 2, line 3, after "hole" insert  
--disadvantageously--, and change "alone, which is" to  
--alone.--.

On page 2, delete line 4.

On page 2, line 6, after "Patent" insert --No.--.

On page 2, line 12, change "known from" to  
--described in--, and after "Patent" insert --No.--.

On page 2, line 16, delete "here".

On page 2, before line 19, insert:  
--SUMMARY--.

On page 2, delete line 20, and insert:  
--has the--.

On page 2, line 21, change "related art" to  
--conventional device--.

On page 2, line 27, change "preferably" to  
--advantageously--.

On page 2, delete lines 30-33.

On page 2, line 35, change "in particular" to --for example--.

On page 3, line 9, change "preferably" to --for example--.

On page 3, line 10, change "holes" to --holes,--.

On page 3, delete line 15-16, and insert:  
--injector against the combustion pressure prevailing in the--.

On page 3, line 17, after "chamber" insert --during the operation of the internal combustion engine--.

On page 3, line 18, change "preferably dimensioned" to --dimensioned, for example,--.

On page 3, line 19, after "can" insert --be--.

On page 3, line 32, change "Preferably" to --For example,--.

On page 4, line 1, delete "particularly".

On page 4, line 12, change "a" to --an--.

On page 4, delete lines 20-37, and insert:

--BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a section through a cylinder head of an internal combustion engine, a first embodiment of an assembling device according to the present invention, and a fuel injector inserted into the assembling device.

Figure 2 shows a top view of a second embodiment of an assembling device that is slightly modified with respect to the first embodiment shown in Figure 1.

Figure 3 shows a section along line III-III of Figure 2.

DETAILED DESCRIPTION--.

On page 5, line 2, change "engine and through" to --engine,--.

On page 5, line 3, delete "as".

On page 5, line 4, change "well as" to --and--.

On page 5, line 13, change "10" to --10,--.

On page 5, line 14, change "27, as well as" to --27 leading--.

On page 5, line 34, change "preferably" to --advantageously--.

On page 5, line 35, change "preferably" to --advantageously--.

On page 6, line 7, change "preferably formed" to --formed, for example,--.

On page 6, line 9, change "conceivable" to --possible--.

On page 7, line 12, change "preferably made of metal, in particular of" to --made, for example, of metal, for example--.

On page 7, line 15, change "formed" to --formed,--.

On page 7, line 21, change "compared" to --in comparison--.

On page 7, line 37, change "ideally" to --for  
example--.

**IN THE ABSTRACT:**

Please amend the Abstract as follows.

Delete line 1, and insert:

-- ABSTRACT--.

Line 3, delete "{1}".

Line 4, delete "{3}" and "{5}".

Line 5, delete "{2}" and "{12}".

Line 6, delete "{3}".

Line 7, delete "{14}" and "{F<sub>N</sub>}".

Line 8, delete "{3}" and "{5}".

Line 9, delete "{F<sub>D</sub>}".

Line 10, delete "{3}" (both occurrences).

Line 11, delete "{13}" and "{5}".

Line 12, delete "{12}" and "{13}".

Line 13, delete "{20}" and "{25}".

Line 14, delete "{25}".

Line 15, delete "{2}".

Line 16, delete "{F<sub>D</sub>}" and "{13}".

Line 17, delete "(1)" and "(3)".

Line 18, delete "(1)".

**IN THE CLAIMS:**

On page 9, delete line 1, and insert:

--What Is Claimed Is:--.

Please cancel claims 1-10, without prejudice.

Please add the following new claims:

11. (New) An assembling device for assembling and disassembling a fuel injector in a mounting hole of a cylinder head of an internal combustion engine, the assembling device comprising:
  - a jacket body having a contact section and a collar section, the jacket body at least partially surrounding the fuel injector, a hold-down force for holding down the fuel injector in the mounting hole and a disassembling force for disassembling the fuel injector being able to be exerted on the fuel injector via the contact section, the collar section protruding from the mounting hole, the collar section having at least one thread into which a disassembling screw can be screwed,wherein:
  - when the disassembling screw is tightened, the disassembling screw abuts the cylinder head and transmits a disassembling force to the collar section so that the assembling device with the fuel injector inserted into the assembling device is extracted from the mounting hole.
12. (New) The device according to claim 11, wherein:
  - a plurality of peripherally distributed threads are arranged on the collar section, each of the peripherally



distributed threads corresponding to a disassembling screw.

13. (New) The device according to claim 12, wherein:

two threads of the plurality of peripherally distributed threads are arranged on the collar section diametrically opposite one another, each of the two threads corresponding to a disassembling screw.

14. (New) The device according to claim 11, wherein:

the collar section has at least one opening in which an assembling screw can be inserted so that the assembling screw engages a thread provided in the cylinder head, and

a hold-down force is transmitted to the collar section by tightening the assembling screw, the hold-down force being such that the assembling device with the fuel injector inserted into the assembling device is held down in the mounting hole.

15. (New) The device according to claim 14, wherein:

a plurality of peripherally distributed openings is arranged on the collar section, each of the plurality of peripherally distributed openings corresponding to an assembling screw.

16. (New) The device according to claim 15, wherein:

three openings are arranged on the collar section at an angular distance of greater than 90° from one another, the three openings being bore holes, each of the three openings corresponding to an assembling screw.

17. (New) The device according to claim 14, wherein:

the at least one thread and the at least one opening are dimensioned so that the assembling screw can be used as a disassembling screw.

18. (New) The device according to claim 11, wherein:  
the contact section has a radial extension directed inward and an axial extension extending axially over the radial extension, the axial extension transmitting the hold-down force to the fuel injector, the radial extension engaging a disassembling groove of the fuel injector in order to transmit a disassembling force to the fuel injector.
19. (New) The device according to claim 18, wherein:  
the radial extension surrounds the fuel injector in a smaller angular area than at least one of the jacket body and the collar section.
20. (New) The device according to claim 11, wherein:  
the device is manufactured from a piece of sheet metal by deep drawing.

#### Remarks

This Preliminary Amendment cancels, without prejudice, claims 1-10 in the underlying PCT Application No. PCT/DE99/03143 and adds new claims 11-20. The new claims conform the claims to U.S. Patent and Trademark Office rules and do not add new matter to the application.

The above amendments to the specification and abstract conform the specification and abstract to U.S. Patent and Trademark Office rules, and do not introduce new matter into the application.

The underlying PCT Application No. PCT/DE99/03143 includes an International Search Report, dated March 2, 2000. The Search Report includes a list of documents that were uncovered in the underlying PCT Application. A copy of the Search Report is included herewith.

It is respectfully submitted that the subject matter of the present application is new, non-obvious, and useful.

Prompt consideration and allowance of the application are respectfully requested.

Respectfully submitted,

Dated: 8/14/00

By: *Richard L. Maye*  
Richard L. Maye  
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ASSEMBLING DEVICE FOR ASSEMBLING AND DISASSEMBLING A FUEL  
INJECTOR

## Background Information

The present invention relates to an assembling device for assembling and disassembling a fuel injector, in particular a high-pressure direct injector, into and from a mounting hole in a cylinder head of an internal combustion engine. Fuel is injected directly into the combustion chamber of the internal combustion engine through this high-pressure direct injector.

The present invention is based on an assembling device according to the definition of the species of the main claim. An assembling device having a jacket body at least partially surrounding the fuel injector is already known from German Patent Application 197 05 990 A1, a collar section directed inward being formed at a first end of the jacket body, and a collar section directed outward being formed at a second end of the jacket body, opposite the first end. While the collar section directed radially inward can be inserted into a groove of the fuel injection valve, the collar section directed outward protrudes outward from the mounting hole of the fuel injection valve. An appropriate tool, for example, an assembling iron, can engage in the collar section protruding from the mounting hole of the cylinder head in order to lift the assembling device together with the fuel injection valve from the mounting hole. In some cases considerable disassembling forces are required because the fuel injection valves because the fuel injectors may seize in their mounting holes. Therefore the cylinder head, which may be made of light metal, for example, may be damaged by the mounting iron or other lifting tools, which is disadvantageous. Furthermore, it is a disadvantage in the case of the known assembling device that the mounting device transmits no hold-down force to the

fuel injector during the operation of the internal combustion engine, but the fuel injector and the assembling device are held in the mounting hole by friction forces alone, which is disadvantageous.

U.S. Patent 4,561,159 describes a disassembling device for a diesel injector. An end area of the fuel injector opposite the spray orifice can be inserted at the side into a slit in the disassembling device. The disassembling device is not inserted into the mounting bore of the cylinder head and it does not remain in the mounting bore when assembled. The disassembling device known from U.S. Patent 4,561,159 is instead a tool extension which is attached to the fuel injector before disassembling the fuel injector. No hold-down force is transmitted to the fuel injector. Connecting the disassembling device to the fuel injector here is a relatively complicated process.

The assembling device according to the present invention having the characterizing features of Claim 1 has the advantage over the related art that the at least one disassembling screw engaging in a thread of the collar section allows simple and damage-free disassembling of the fuel injector inserted into the assembling device. Disassembling takes place so that the assembling device with the fuel injector is continuously extracted from the mounting hole by tightening the at least one disassembling screw or preferably the plurality of disassembling screws.

Advantageous refinements of and improvements on the assembling device characterized in the main claim are possible through the measures characterized in the subordinate claims.

The threads, each assigned to a disassembling screw, peripherally distributed on the collar section, in particular two threads for two disassembling screws, can ensure that the disassembling force resulting from the tightening of the

plurality of disassembling screws is directed axially, so that increased friction lock due to a radial force component is avoided. A symmetric, continuous pulling force is achieved through the simultaneous tightening of the disassembling screws. As an alternative, disassembling can also be performed by tightening the plurality of disassembling screws alternately.

It is particularly advantageous that openings, preferably in the form of bore holes are provided on the collar section, through which assembling screws engage a thread of the cylinder head. By tightening these assembling screws, sufficient hold-down force is transmitted to the assembling device and thus to the fuel injector to hold down the fuel injector during the operation of the internal combustion engine against the combustion pressure prevailing in the combustion chamber. The threads and the openings in the collar section are preferably dimensioned so that the assembling screws can be used as disassembling screws at the same time. For this purpose, the threads in the cylinder head and the collar section of the assembling device must have the same diameter and the same taper, and the openings must be dimensioned so that the corresponding screw diameters pass through them. When the fuel injector is disassembled, the mounting screws are loosened first and then the mounting screws used as disassembling screws are introduced in the thread of the collar section and tightened, whereby the assembling device with the fuel injector is extracted of the mounting hole in the cylinder head. No special disassembling screws need to be provided.

Preferably at least three openings spaced at an angular distance of  $90^\circ$ , are provided for the mounting screws. This ensures that the hold-down force on the assembling device and thus on the fuel injector is applied uniformly over the periphery.

According to a particularly advantageous embodiment, the contact section of the assembling device engaging the fuel injector has an extension directed radially inward and an axial extension extending axially beyond the radial extension. The axial extension is used for transmitting the hold-down force to the fuel injector, while the radial extension engages a groove of the fuel injector to transmit the disassembling force to the fuel injector. The functions of hold-down and disassembling are separated on the contact section of the assembling device engaging the fuel injector. This has the advantage that the area of the disassembling groove of the fuel injector can be implemented by a injected plastic piece, and the area of the fuel injector engaged by the axial extension must be made of metal. This results in simple and cost-effective manufacturing of the fuel injector housing.

The assembling device can be economically manufactured by deep drawing from sheet metal.

#### Drawing

Embodiments of the present invention are illustrated in a simplified form in the drawing and are explained in greater detail in the following description.

Figure 1 shows a section through a cylinder head of an internal combustion engine and an embodiment of the assembling device according to the present invention, as well as a fuel injector inserted into the assembling device;

Figure 2 shows an embodiment slightly modified with respect to that of Figure 1 in top view, and

Figure 3 shows a section along line III-III of Figure 2.

#### Detailed Description of the Embodiments

Figure 1 shows a section through a cylinder head 2 of an internal combustion engine and through an embodiment of assembling device 1 according to the present invention, as well as a fuel injector 3 shown unsectioned, inserted into assembling device 1 according to the present invention.

Fuel injector 3 is used for direct injection of fuel into a combustion chamber 4 of the internal combustion engine. Cylinder head 2 has a mounting hole 5 to accommodate fuel injector 3, which in the embodiment illustrated is divided into a narrow section 6 to accommodate an injection section 7 of fuel injector 3, a widened section 8 to accommodate a disassembling section 9, a fuel feed section 10 and a housing body 27, as well as into a conical section 11 connecting widened section 8 to narrow section 6.

Assembling device 1 according to the present invention has a jacket body 12, which at least partially surrounds fuel injector 3; a collar section 13 directed outward from mounting hole 5 and extending radially outward from jacket body 12, is formed on jacket body 12. A contact section 14 is formed at the end opposite collar section 13 of jacket body 12, through which assembling device 1 engages with fuel injector 3.

Contact section 14 has an extension 15 directed radially inward and an axial extension 16 extending axially beyond radial extension 15. Radial extension 15 engages in a disassembling groove 17 of fuel injector 3, in order to transmit a disassembling force to fuel injector 3. Axial extension 16 engages in a hold-down surface 18 of fuel injector 3 in order to transmit a hold-down force to fuel injector 3.

At least one, however, preferably a plurality of unthreaded openings 19 and at least one, however, preferably a plurality of threaded opening 20 are provided with threads 20 on collar section 13 of assembling device 1. Openings 19 are designed in



5 this embodiment as unthreaded boreholes, traversed by assembling screws 21, which can be screwed into threaded boreholes 22 of cylinder head 2. Openings 19 may be also designed as elongated holes, slots, recesses opening outward, or the like, for example.

10 Threads 20 are preferably formed in threaded holes, with thread 20 being cut directly into collar section 13. It is, however, also conceivable to attach threaded bushings or nuts to collar section 13 of assembling device 1.

15 When fuel injector 3 is assembled, fuel injector 3 is initially inserted into assembling device 1 so that radial extension 15 engages in disassembling groove 17 of fuel injector 3. Then assembling device 1, together with fuel injector 3, is inserted into mounting hole 5 of cylinder head 2. Finally, assembling screws 21 are inserted through openings 19 in collar section 13 and screwed into threads 22 of cylinder head 2. Screw heads 23 of assembling screws 21 contact collar section 13 when assembling screws 21 are tightened and exert a hold-down force  $F_h$  indicated by arrow 24 on assembling device 1, which is transmitted via axial extension 16 to hold-down surface 18 of fuel injector 3. Thus, fuel injector 3 is held down in mounting hole 5 against the combustion pressure in combustion chamber 5 during the operation of the internal combustion engine.

25 In order to disassemble fuel injector 3 and assembling device 1, assembling screws 21 are initially loosened and removed from thread 22 of cylinder head 2. Then disassembling screws 25 are inserted into thread 22 of collar section 13, abutting on cylinder head 2. A disassembling force  $F_d$ , indicated by arrow 26, is then exerted on assembling device 1; this force is transmitted to disassembling groove 17 of fuel injector 3 via radial extension 15. Thus assembling device 1, together with fuel injector 3 is extracted from mounting hole 5 of cylinder head 2 without need for an assembling iron or another

lifting tool. Relatively large disassembling forces  $F_D$  can be exerted on assembling device 1 and fuel injector 3 via disassembling screws 25, so that fuel injector 3 can be reliably removed to be serviced or replaced even if fuel injector 3 has become seized in mounting hole 5.

Due to the fact that both a radial extension 15 and an axial extension 16 are formed on contact section 14 of assembling device 1, the hold-down and disassembling functions are separated from one another. While housing body 27 of fuel injector 3 on which hold-down surface 18 is formed is preferably made of metal, in particular of steel, in order to enable it to transmit a high hold-down force to fuel injector 3, disassembling section 9 of fuel injector, on which disassembling groove 17 is formed can be manufactured as an injected plastic piece, since disassembling force  $F_D$  is considerably less than hold-down force  $F_N$ . This allows fuel injector 3 to be manufactured inexpensively.

Figure 2 shows the top view of an embodiment slightly modified compared to that shown in Figure 1 of an assembling device 1 according to the present invention. Radial extension 15, collar section 13, thread 20 formed on collar section 13, and openings 19 designed as unthreaded bore holes on collar section 13 can be seen. The modification with respect to the embodiment illustrated in Figure 1 is that two threads formed in the threaded bore holes on collar section 13 are diametrically opposite in section plane III-III, while in the embodiment illustrated in Figure 1, one thread 20 and one unthreaded opening 19 are arranged in section plane III-III to better illustrate the present invention.

While both threads 20 on collar section 13 are arranged diametrically opposite one another, three unthreaded openings 19 on collar section 13 are peripherally distributed almost uniformly so that the angular spacing between the individual openings is at least  $90^\circ$ , ideally  $120^\circ$ . Thus a peripherally

uniform hold-down force can be transmitted to fuel injector 3 via assembling device 1 according to the present invention.

As can also be seen from Figure 2, in the embodiment illustrated in Figure 2, radial extension 15 surrounds fuel injector 3 not illustrated in Figure 2 in a smaller angular area than jacket body 12 and/or collar section 13 formed on jacket body 12. This facilitates insertion of fuel injector 3 into assembling device 1.

Figure 3 shows a section along line III-III in Figure 2. The illustration largely corresponds to the illustration of assembling device 1 of Figure 1 with the difference that, as explained previously, two threads 20 are arranged instead of one thread 20 and one unthreaded opening 19.

Assembling device 1 according to the present invention can be manufactured economically as a deep-drawn sheet metal part. Threads 22 on cylinder head 2 and threads 20 on collar 13 of assembling device 1 have the same diameter and the same taper, so that assembling screws 21 can be used as disassembling screws 25 at the same time. Therefore, in order to disassemble assembling device 1 and fuel injector 3, assembling screws 21 are first loosened and removed and then inserted into threads 20 and tightened.

Using assembling device 1 according to the present invention, high symmetric disassembling forces directed axially can be transmitted to fuel injector 3, preventing damage to cylinder head 2 made of light metal, for example.

The present invention is not restricted to the embodiments presented. For example, radial extension 15 may also be implemented via notches on jacket body 12 that are bent so that they protrude radially inward.

## Claims

1. An assembling device (1) for assembling and disassembling a fuel injector (3) in a mounting hole (5) of a cylinder head (2) of an internal combustion engine having a jacket body (12) at least partially surrounding the fuel injector (3), on which jacket body a contact section (14), through which both a hold-down force ( $F_H$ ) for holding down the fuel injector (3) in the mounting hole (5) and a disassembling force ( $F_D$ ) for disassembling the fuel injector (3) can be exerted on the fuel injector (3), and a collar section (13) protruding from the mounting hole (5) are formed, characterized in that the collar section (13) has at least one thread (20), into which a disassembling screw (25) can be screwed so that when the disassembling screw (25) is tightened, it abuts on the cylinder head (2) and transmits such a disassembling force ( $F_D$ ) to the collar section (13) that the assembling device (1) with the fuel injector (3) inserted into the assembling device (1) is extracted from the mounting hole (5).
2. The assembling device according to Claim 1, characterized in that a plurality of peripherally distributed threads (20), each for one disassembling screw (25), are arranged on the collar section (13).
3. The assembling device according to Claim 2, characterized in that two threads (20), each for one disassembling screw (25), are arranged on the collar section (13) diametrically opposite one another.
4. The assembling device according to one of Claims 1 through 3, characterized in that at least one opening (19) is provided on the collar section (13), in which opening an assembling screw (21) can be inserted so that the assembling screw (21) engages in a thread (22) provided in the cylinder head (2), a hold-

down force ( $F_N$ ) such that the assembling device (1) with the fuel injector (3) inserted into the assembling device (1) is held down in the mounting hole (5) being transmitted to the collar section (13) by tightening the assembling screw (21).

5. The assembling device according to Claim 4, characterized in that a plurality of peripherally distributed openings (19), each for one assembling screw (21), are arranged on the collar section (13).

6. The assembling device according to Claim 5, characterized in that three openings (19) in the form of bore holes (19), each for one assembling screw (21), are arranged on the collar section (13) at an angular distance of more than  $90^\circ$  from one another.

7. The assembling device according to Claims 4 through 6, characterized in that the threads (20) and openings (19) in the collar section (13) are dimensioned so that the assembling screws (21) can be used as disassembling screws (25).

8. The assembling device according to one of Claims 1 through 7, characterized in that the contact section (14) has a radial extension (15) directed inward and an axial extension (16) extending axially over the radial extension (15), the axial extension (16) transmitting the hold-down force ( $F_N$ ) to the fuel injector (3) and the radial extension (15) engaging in a disassembling groove (17) of the fuel injector (3) in order to transmit a disassembling force ( $F_D$ ) to the fuel injector (3).

9. The assembling device according to Claim 8, characterized in that the radial extension (15) surrounds the fuel injector (3) in a smaller angular area than the jacket body (12) and/or the collar section (13).

10. The assembling device according to Claims 1 through 9,

characterized in that the assembling device (1) is  
manufactured by deep drawing from a piece of sheet metal.

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## Abstract

An assembling device (1) for assembling and disassembling a fuel injector (3) in a mounting hole (5) of a cylinder head (2) of an internal combustion engine has a jacket body (12) at least partially surrounding the fuel injector (3). A contact section (14), on which both a hold-down force ( $F_N$ ) for holding down the fuel injector (3) in the mounting hole (5) and a disassembling force ( $F_D$ ) for disassembling the fuel injector (3) can be exerted on the fuel injector (3), and a collar section (13) protruding from the mounting hole (5) are formed on the jacket body (12). The collar section (13) has at least one thread (20), in which a disassembling screw (25) can be screwed in so that when the disassembling screw (25) is tightened it abuts on the cylinder head (2) and transmits a disassembling force ( $F_D$ ) on the collar section (13) so that the assembling device (1) with the fuel injector (3) inserted into the assembling device (1) is extracted.

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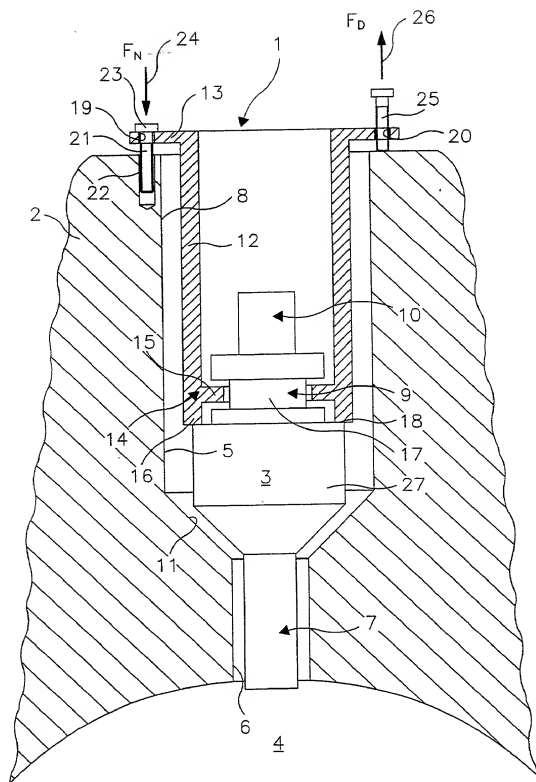


Fig.1



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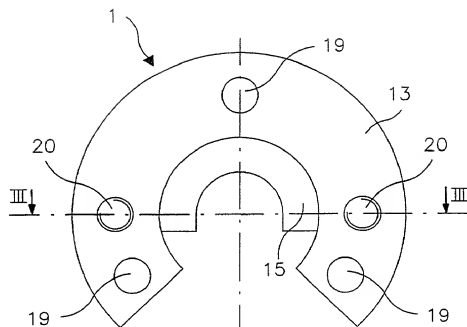


Fig.2

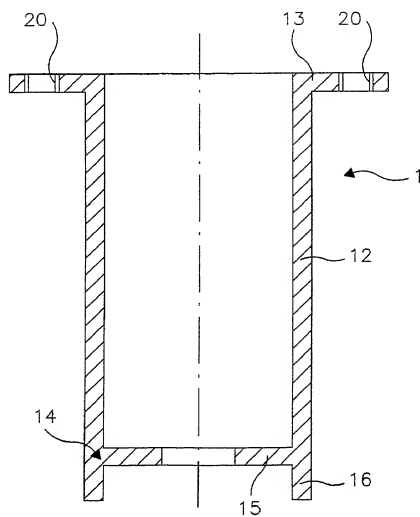


Fig.3

COMBINED DECLARATION AND  
POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below adjacent  
to my name.

I believe I am the original, first and sole inventor (if only one name is listed  
below) or an original, first and joint inventor (if plural names are listed below) of the subject  
matter which is claimed and for which a patent is sought on the invention entitled  
**ASSEMBLING DEVICE FOR ASSEMBLING AND DISASSEMBLING A FUEL  
INJECTOR** and the specification of which:

- ☐ is attached hereto;
- ☐ was filed as United States Application Serial No. 09/622,290 on  
\_\_\_\_\_, 19\_\_ and was amended by the Preliminary Amendment  
filed on \_\_\_\_\_, 19\_\_.
- ☒ was filed as PCT International Application Number PCT/DE99/03143,  
on the 30th day of September, 1999
- ☐ an English translation of which is filed herewith.

I hereby state that I have reviewed and understand the contents of the above-  
identified specification, including the claims, as amended by any amendment referred to  
above.

I acknowledge the duty to disclose information which is material to the  
examination of this application in accordance with Title 37, Code of Federal Regulations,  
§1.56(a). I hereby claim foreign priority benefits under Title 35, United States Code § 119 of  
any foreign application(s) for patent or inventor's certificate or of any PCT international  
applications(s) designating at least one country other than the United States of America listed  
below and have also identified below any foreign application(s) for patent or inventor's  
certificate or any PCT international application(s) designating at least one country other than  
the United States of America filed by me on the same subject matter having a filing date  
before that of the application(s) of which priority is claimed:

**PRIOR FOREIGN/PCT APPLICATION(S)  
AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119**

Country : Federal Republic of Germany

Application No. : 198 57 485.1

Date of Filing: December 14, 1998

Priority Claimed  
Under 35 U.S.C. § 119 : ☒ Yes ☐ No

I hereby claim the benefit under Title 35, United States Code § 120 of any United States Application or PCT International Application designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations § 1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

**PRIOR U.S. APPLICATIONS OR  
PCT INTERNATIONAL APPLICATIONS  
DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. § 120**

**U.S. APPLICATIONS**

Number :

Filing Date :

**PCT APPLICATIONS  
DESIGNATING THE U.S.**

PCT Number :

PCT Filing Date :

I hereby appoint the following attorney(s) and/or agents to prosecute the above-identified application and transact all business in the Patent and Trademark Office

connected therewith.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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